Claims:

1. A method of processing a digital image, comprising the steps of:

providing digital data indexed to represent positions on a display, said digital data being indicative of an intensity value $I_i(x,y)$ for each position (x,y) in each i-th spectral band;

adjusting said intensity value for said each position in each i-th spectral band to generate an adjusted intensity value for said each position in each i-th spectral band in accordance with

$$\sum_{n=1}^{N} W_n \left(\log I_i(x,y) - \log[I_i(x,y) * F_n(x,y)] \right), \quad i=1,\dots,S$$

where S is the number of unique spectral bands included in said digital data and, for each n, W_n is a weighting factor and $F_n(x,y)$ is a unique surround function applied to said each position (x,y) and N is the total number of unique surround functions;

filtering said adjusted intensity value for said each position of said image in each of said S spectral bands using a filter function wherein a filtered intensity value $R_i(x,y)$ is defined; and

selecting a maximum intensity value $V_i(x,y)$ from the group consisting of said intensity value $I_i(x,y)$ and said filtered intensity value $R_i(x,y)$.

1   2.   A method according to claim 1 wherein each said unique

2   surround function is a Gaussian function.

1   3.   A method according to claim 2 wherein said Gaussian

2   function is of the form

$$e^{\frac{-r^2}{c_n^2}}$$

3   satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} \, dxdy = 1$$

where

$$r = \sqrt{x^2 + y^2}$$

and, for each n, k_n is a normalization constant and c_n is a
unique constant for each of said N unique surround functions.

4. A method according to claim 1 further comprising the step of multiplying said filtered intensity value $R_i(x,y)$ by

$$\log\left[\frac{BI_i(x,y)}{\sum\limits_{i=1}^{s} I_i(x,y)}\right]$$

to define a color-restored intensity value $R'_i(x,y)$, where B is a constant, wherein said step of selecting using said filtered intensity value $R_i(x,y)$ is replaced with the step of selecting a maximum intensity value $V_i(x,y)$ from the group consisting of said intensity value $I_i(x,y)$ and said color-restored intensity value $R'_i(x,y)$.

5. A method according to claim 1 wherein said each position (x,y) defines a pixel of said display.

6. A method according to claim 1 wherein, for each n, $W_n=1/N$.

7. A method according to claim 1 further comprising the step of displaying an improved image using said maximum intensity value $V_i(x,y)$.

8. A method according to claim 4 further comprising the step of displaying an improved image using said maximum intensity value $V_i(x,y)$.

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9. A method according to claim 1 further comprising the steps
of:

 defining a classification of said image based on dynamic
range of said image in each of said S spectral bands; and

 selecting said filter function based on said
classification of said image.

10. A method according to claim 9 wherein said step of
defining comprises the step of using image statistics
associated with said image in each of said S spectral bands.

11. A method according to claim 10 wherein said image
statistics include brightness and contrast of said image in
each of said S spectral bands.

12. A method according to claim 4 further comprising the
steps of:

 defining a classification of said image based on dynamic
range of said image in each of said S spectral bands; and

 selecting said filter function based on said
classification of said image.

13. A method according to claim 12 wherein said step of
defining comprises the step of using image statistics
associated with said image in each of said S spectral bands.

1   14.   A method according to claim 13 wherein said image

2   statistics include brightness and contrast of said image in

3   each of said S spectral bands.

1   15.   A method of processing a digital image, comprising the

2   steps of:

3   providing digital data indexed to represent the positions

4   of a plurality of pixels of a J-row by K-column display, said

5   digital data being indicative of an intensity value I(x,y) for

6   each of said plurality of pixels where x is an index of a

7   position in the J-th row of said display and y is an index of

8   a position in the K-th column of said display wherein a JxK

9   image is defined;

10   convolving said digital data associated with each of said

plurality of pixels with a function

$$e^{\frac{-r^2}{c^2}}$$

to form a discrete convolution value for each of said

plurality of pixels, said function satisfying the relationship

$$k\iint e^{\frac{-r^2}{c^2}}\,dxdy = 1$$

where

$$r = \sqrt{x^2+y^2}$$

15   k is a normalization constant and c is a constant;

16   converting, for each of said plurality of pixels, said

17   discrete convolution value into the logarithm domain;

18   converting, for each of said plurality of pixels, said

19   intensity value into the logarithm domain;

20   subtracting, for each of said plurality of pixels, said

21   discrete convolution value so-converted into the logarithm

22   domain from said intensity value so-converted into the

23   logarithm domain, wherein an adjusted intensity value is

24   generated for each of said plurality of pixels;

25   filtering said adjusted intensity value for each of said

26   plurality of pixels with a filter function wherein a filtered

27   intensity value R(x,y) is defined; and

28   selecting, for each of said plurality of pixels, a

29   maximum intensity value V(x,y) from the group consisting of

30   said intensity value I(x,y) and said filtered intensity value

31   R(x,y).

16.   A method according to claim 15 wherein the value of said

constant c is selected to be in the range of approximately

0.01 to approximately 0.5 of the larger of J and K.

1   17.   A method according to claim 15 further comprising the

2   step of displaying an improved image using said maximum

3   intensity value V(x,y).

1   18.   A method according to claim 15 wherein said step of

2   filtering includes the step of selecting said filter function

3   based on dynamic range of said JxK image.

1   19. A method of processing a digital image, comprising the

2   steps of:

3   providing digital data indexed to represent the positions

4   of a plurality of pixels of an J-row by K-column display, said

5   digital data being indicative of an intensity value $I_i(x,y)$

6   for each i-th spectral band of S spectral bands for each of

7   said plurality of pixels where x is an index of a position in

8   the J-th row of said display and y is an index of a position

9   in the K-th column of said display wherein a $(JxK)_i$ image is

10   defined for each of said S spectral bands and a JxK image is

11   defined across all of said S spectral bands;

12   convolving said digital data associated with each of said

13   plurality of pixels in each i-th spectral band with a function

$$e^{\frac{-r^2}{c_n^2}}$$

14   for n=2 to N to form N convolution values for each of said

15   plurality of pixels in each said i-th spectral band, said

16   function satisfying the relationship

$$k_n \int\int e^{\frac{-r^2}{c_n^2}}\, dxdy = 1$$

17   where

$$r = \sqrt{x^2+y^2}$$

18   and, for each n, k_n is a normalization constant and c_n is a

19   unique constant;

20   converting, for each of said plurality of pixels in each

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said i-th spectral band, each of said N convolution values
into the logarithm domain;

converting, for each of said plurality of pixels in each said i-th spectral band, said intensity value into the logarithm domain;

subtracting, for each of said plurality of pixels in each said i-th spectral band, each of said N convolution values so-converted into the logarithm domain from said intensity value so-converted into the logarithm domain, wherein an adjusted intensity value is generated for each of said plurality of pixels in each said i-th spectral band based on each of said N convolution values;

forming a weighted sum for each of said plurality of pixels in each said i-th spectral band using said adjusted intensity values;

filtering said weighted sum for each of said plurality of pixels in each said i-th spectral band with a filter function wherein a filtered intensity value $R_i(x,y)$ is defined; and

selecting a maximum intensity value $V_i(x,y)$ from the group consisting of said intensity value $I_i(x,y)$ and said filtered intensity value $R_i(x,y)$.

20. A method according to claim 19 wherein the value for each said unique constant c_n is selected to be in the range of approximately 0.01 to approximately 0.5 of the larger of J and K.

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1   21. A method according to claim 19 further comprising the

2   step of multiplying said filtered intensity value $R_i(x,y)$ by

$$\log \left[\frac{BI_i(x,y)}{\sum_{i=1}^{s} I_i(x,y)} \right]$$

3   to define a color-restored intensity value $R'_i(x,y)$, where B

4   is a constant and S is a whole number greater than or equal to

5   2, wherein said step of selecting using said filtered

6   intensity value $R_i(x,y)$ is replaced with the step of selecting

7   a maximum intensity value $V_i(x,y)$ from the group consisting of

8   said intensity value $I_i(x,y)$ and said color-restored intensity

9   value $R'_i(x,y)$.

22. A method according to claim 19 further comprising the

step of displaying an improved image using said maximum

intensity value $V_i(x,y)$.

1   23. A method according to claim 21 further comprising the

2   step of displaying an improved image using said maximum

3   intensity value $V_i(x,y)$.

1   24. A method according to claim 19 further comprising the

2   steps of:

3   defining a classification of said JxK image based on

4   dynamic range of each said $(JxK)_i$ image; and

5   selecting said filter function based on said

6   classification of said JxK image.

25. A method according to claim 24 wherein said step of

defining comprises the step of using image statistics

associated with each said $(JxK)_i$ image.

26. A method according to claim 25 wherein said image

statistics include brightness and contrast of each said $(JxK)_i$

3   image.

1   27. A method according to claim 21 further comprising the

2   steps of:

3   defining a classification of said JxK image based on

4   dynamic range of each said $(JxK)_i$ image; and

5   selecting said filter function based on said

6   classification of said JxK image.

1   28. A method according to claim 27 wherein said step of

2   defining comprises the step of using image statistics

3   associated with each said $(JxK)_i$ image.

1   29. A method according to claim 28 wherein said image

2   statistics include brightness and contrast of each said $(JxK)_i$

3   image.

1   30. A method of processing a digital image, comprising the

2   steps of:

3   providing digital data indexed to represent positions of

4   an image having S spectral bands for simultaneous output on a

5   display, said digital data being indicative of an intensity

6   value $I_i(x,y)$ for each position (x,y) in each i-th spectral

7   band;

8   adjusting said intensity value for said each position in

9   each i-th spectral band to generate an adjusted intensity

10   value for said each position in each i-th spectral band in

accordance with

$$\sum_{n=1}^{N} W_n \left(\log I_i(x,y) - \log[I_i(x,y) * F_n(x,y)] \right), \quad i=1,\ldots,S$$

12   where S is a whole number greater than or equal to 2 and

13   defines the total number of spectral bands included in said

14   digital data and, for each n, W_n is a weighting factor and

15    $F_n(x,y)$ is a unique surround function of the form

$$e^{\frac{-r^2}{c_n^2}}$$

16   satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} \, dxdy = 1$$

17   where

$$r = \sqrt{x^2+y^2}$$

18   and, for each n, k_n is a normalization constant and c_n is a

unique constant where N is the total number of unique surround

functions;

filtering said adjusted intensity value for said each

position in each i-th spectral band with a filter function

wherein a filtered intensity value $R_i(x,y)$ is defined;

multiplying said filtered intensity value $R_i(x,y)$ by

$$\log \left[\frac{BI_i(x,y)}{\sum_{i=1}^{s} I_i(x,y)} \right]$$

to define a color-restored intensity value $R'_i(x,y)$, where B

is a constant; and

selecting a maximum intensity value $V_i(x,y)$ from the

group consisting of said intensity value $I_i(x,y)$ and said

color-restored intensity value $R'_i(x,y)$.

31. A method according to claim 30 wherein, for each n,
$W_n = 1/N$.

32. A method according to claim 30 wherein the value for each

said unique constant c_n is selected to be in the range of

approximately 0.01 to approximately 0.5 of the larger of J and

K.

33. A method according to claim 30 further comprising the

step of displaying an improved image using said maximum

intensity value $V_i(x,y)$.

1   34.   A method according to claim 30 further comprising the
2   steps of:
3   defining a classification of said image based on dynamic
4   range of said image in each of said S spectral bands; and
5   selecting   said   filter   function   based   on   said
6   classification of said image.

1   35.   A method according to claim 34 wherein said step of
2   defining   comprises   the   step   of   using   image   statistics
    associated with said image in each of said S spectral bands.

    36.   A method according to claim 35 wherein said image
    statistics include brightness and contrast of said image in
    each of said S spectral bands.